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vessel when the pressure of the inerting, padding, or purging gas exceeds 90 percent of the lowest setting of any pressure relief valve on the vessel; and

(3) Locate the pressure-sensing devices required by paragraphs (n)(1) and (n)(2) of this section in the inerting, padding, or purging gas piping downstream of any devices in the gas piping that could potentially isolate the vessel from the sensing devices.

§ 154.2104 Pigging system.

(a) If a pigging system is used to clear cargo in the cargo lines to the tank vessel while the vessel is connected to the facility vapor control system (VCS), the pigging system must be designed with the following safety features:

(1) A bypass loop installed in the main liquid cargo line that contains the pig-receiving device, through which all the liquid flow is channeled during pigging operations. The pig must act as a seal to separate the vessel from the compressed inert gas that is used to propel it as the pig travels from the pig launcher to the pig-receiving device;

(2) A mechanism for restricting liquid and gas flow so that the vessel, personnel, and environment are not endangered. The compressed inert gas flow capacity that this mechanism secures must not be more than 95 percent of the combined capacity of all vessel and facility VCS relief valves located upstream of the facility's remotely operated cargo vapor shutoff valve required by 33 CFR 154.2101(a);

(3) A fast-action automatic shutoff valve such as a solenoid valve, which closes on a high-pressure signal from the pressure sensor required by 33 CFR 154.2103(f), located in the liquid bypass loop downstream of the pig-receiving device;

(4) An interlock with the main cargo line manual block valve so that line-clearing operations cannot begin unless the main cargo line manual block valve is closed; and

(5) An automatic means to detect arrival of the pig at the pig-receiving device.

(b) If a cargo line clearance system without using pigging is used to clear cargo in the cargo lines to the tank

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vessel while the vessel is connected to the facility VCS, the cargo line clearance system must be approved by the Commandant.

§ 154.2105 Fire, explosion, and detonation protection.

This section applies only to facilities that control vapors of flammable, combustible, or non-high flash point liquid cargoes.

(a) A vapor control system (VCS) with a single facility vapor connection that receives inerted cargo vapor from a vessel and processes it with a vapor recovery unit must—

(1) Be capable of inerting the vapor collection line in accordance with 33 CFR 154.2107(a) before receiving the vessel's vapor and have at least one oxygen analyzer, which satisfies the requirements of 33 CFR 154.2107(f)(1) and (2), (g), and (h)(2) and (3), sampling the vapor concentration continuously at a point as close as practicable to the facility vapor connection. The total pipe length between the analyzer and the facility vapor connection must not exceed 6 meters (19.7 feet); or

(2) Have a detonation arrester located as close as practicable to the facility vapor connection. The total pipe length between the detonation arrester and the facility vapor connection must not exceed 18 meters (59.1 feet) and the vapor piping between the detonation arrester and the facility vapor connection must be protected from any potential internal or external ignition source.

(b) A VCS with a single facility vapor connection that receives only inerted cargo vapor from a vessel and processes it with a vapor destruction unit must—

(1) Satisfy the requirements of paragraph (a)(1) of this section and have a detonation arrester located as close as practicable to the facility vapor connection. The oxygen analyzer required by paragraph (a)(1) can be located 4 meters (13.1 feet) downstream of the detonation arrester. The total pipe length between the detonation arrester and the facility vapor connection must not exceed 18 meters (59.1 feet) and the vapor piping between the detonation

arrester and the facility vapor connection must be protected from any potential internal or external ignition source; or

(2) Have an inerting system that meets the requirements of 33 CFR 154.2107.

(c) A VCS with a single facility vapor connection that receives vapor from a vessel with cargo tanks that are not inerted or are partially inerted, and processes it with a vapor recovery unit must—

(1) Have a detonation arrester located as close as practicable to the facility vapor connection. The total pipe length between the detonation arrester and the facility vapor connection must not exceed 18 meters (59.1 feet) and the vapor piping between the detonation arrester and the facility vapor connection must be protected from any potential internal or external ignition source; or

(2) Have an inerting, enriching, or diluting system that meets the requirements of 33 CFR 154.2107.

(d) A VCS with a single facility vapor connection that receives vapor from a vessel with cargo tanks that are not inerted or are partially inerted, and processes the vapor with a vapor destruction unit must—

(1) Have a detonation arrester located as close as practicable to the facility vapor connection. The total pipe length between the detonation arrester and the facility vapor connection must not exceed 18 meters (59.1 feet) and the vapor piping between the detonation arrester and the facility vapor connection must be protected from any potential internal or external ignition source; and

(2) Have an inerting, enriching, or diluting system that satisfies the requirements of 33 CFR 154.2107.

(e) A VCS with multiple facility vapor connections that receives vapor from vessels with cargo tanks that carry inerted, partially inerted, non-inerted, or combinations of inerted, partially inerted, and non-inerted cargoes, and processes them with a vapor recovery unit, must have a detonation arrester located as close as practicable to each facility vapor connection. The total pipe length between the detonation arrester and each facility vapor

connection must not exceed 18 meters (59.1 feet) and the vapor piping between the detonation arrester and the facility vapor connection must be protected from any potential internal or external ignition source.

(f) A VCS with multiple facility vapor connections that receives only inerted cargo vapor from vessels and processes it with a vapor destruction unit must—

(1) Satisfy the requirements of paragraph (a)(1) of this section for each facility vapor connection and have a detonation arrester located as close as practicable to each facility vapor connection. The oxygen analyzer required by paragraph (a)(1) can be located 4 meters (13.1 feet) downstream of the detonation arrester. The total pipe length between the detonation arrester and each facility vapor connection must not exceed 18 meters (59.1 feet) and the vapor piping between the detonation arrester and the facility vapor connection must be protected from any potential internal or external ignition source; or

(2) Have an inerting, enriching, or diluting system that meets the requirements of 33 CFR 154.2107.

(g) A VCS with multiple facility vapor connections that receives vapor from vessels with non-inerted or partially inerted cargoes, and processes the vapor with a vapor destruction unit must—

(1) Have a detonation arrester located as close as practicable to each facility vapor connection. The total pipe length between the detonation arrester and each facility vapor connection must not exceed 18 meters (59.1 feet) and the vapor piping between the detonation arrester and the facility vapor connection must be protected from any potential internal or external ignition source; and

(2) Have an inerting, enriching, or diluting system that meets the requirements of 33 CFR 154.2107.

(h) A VCS with multiple facility vapor connections that simultaneously receives vapor from vessels with inerted, partially inerted, and non-inerted cargoes, and processes the vapor with a vapor destruction unit must—

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(1) Have a detonation arrester located as close as practicable to each facility vapor connection. The total pipe length between the detonation arrester and each facility vapor connection must not exceed 18 meters (59.1 feet) and the vapor piping between the detonation arrester and the facility vapor connection must be protected from any potential internal or external ignition source; and

(2) Have either an inerting, enriching, or diluting system that meets the requirements of 33 CFR 154.2107, or a base loading system that meets the requirements of 33 CFR 154.2107(m).

(i) A VCS that uses a vapor balancing system in which cargo vapor from a vessel or facility storage tank is transferred through the facility vapor collection system to facility storage tanks or a vessel must meet the requirements of 33 CFR 154.2110.

(j) Each outlet of a VCS that vents to the atmosphere, except for a discharge vent from a vapor destruction unit or relief valve installed to comply with 33 CFR 154.2103(j) and (k) or 33 CFR 154.2203(e), (k), and (l), must have one of the following located at the outlet:

(1) A detonation arrester;

(2) An end-of-line flame arrester that meets ASTM F 1273 (incorporated by reference, see 33 CFR 154.106); or

(3) An end-of-line flame arrester that meets UL 525 (incorporated by reference, see 33 CFR 154.106) if—

(i) The discharge vent stream's total flammable concentration is proven to be less than 50 percent of the lower flammable limit, or the stream's oxygen concentration is proven to be less than 70 percent by volume of the MOCC, at all times by an outlet concentration analyzer for carbon beds, proof of correct operating temperature for refrigeration systems, or proof of scrubbing medium flow for scrubbers; and

(ii) The proving devices in paragraph (j)(2)(i) of this section close the remotely operated cargo vapor shutoff valve required in 33 CFR 154.2101(a) and close the automatic liquid cargo loading valve if operating outside the conditions necessary to maintain the discharge vent non-combustible.

§ 154.2106 Detonation arresters installation.

This section applies only to facilities collecting vapors of flammable, combustible, or non-high flash point liquid cargoes.

(a) Detonation arresters must be installed in accordance with the guidelines outlined in the arrester manufacturer's acceptance letter provided by the Coast Guard.

(b) On either side of a detonation arrester, line size expansions must be in a straight pipe run and must be no closer than 120 times the pipe's diameter from the detonation arrester unless the manufacturer has test data to show the expansion can be closer.

§ 154.2107 Inerting, enriching, and diluting systems.

This section applies only to facilities that control vapors of flammable, combustible, or non-high flash point liquid cargoes.

(a) Before receiving cargo vapor, a vapor control system (VCS) that uses a gas for inerting, enriching, or diluting must be capable of inerting, enriching, or diluting the vapor collection system, at a minimum of two system volume exchanges of inerting, enriching, or diluting gas, downstream of the injection point.

(b) A VCS that uses an inerting, enriching, or diluting system must be equipped, except as permitted by 33 CFR 154.2105(a), with a gas injection and mixing arrangement located as close as practicable to the facility vapor connection and no closer than 10 meters (32.8 feet) upstream from the vapor processing unit or the vapor-moving device that is not protected by a detonation arrester required by 33 CFR 154.2108(b). The total pipe length between the arrangement and the facility vapor connection must not exceed 22 meters (72.2 feet). The arrangement must be such that it provides complete mixing of the gases within 20 pipe diameters of the injection point. The vapor piping between the arrangement and the facility vapor connection must be protected from any potential internal or external ignition source.

(c) A VCS that uses an inerting or enriching system may not be operated at